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Heart Rate As A Risk Factor

- General population
- Hypertension
- Elderly
- IHD
- Heart Failure
- Cancer

2

HR as Risk Factor in General Population

↑Increase in heart rate = ↑ ACM, CVD

Epidemiological Study	Heart Rate	Sample	Gender/age (years)	Follow up (years)
• Framingham Heart Study[1]	≥ 85	5070	Men/women	36
• Chicago Peoples Gas[2]	≤ 55... ≥ 94	1233	Men 40-59	15
• Chicago Western Electric[2]	≤ 60... ≥ 100	1899	Men 40-55	17
• Chicago Heart Association[2]	≤ 59... ≥ 100	5784	Men 45-69	5
• NHANES I Follow-up Study[3]	≤ 74, 74-84, ≥ 84	6672	Men/women 25-74	10
• Primary Prevention, Goteberg[4]		10 004	Men 45-55	12
• The CORDIS Study[5]	≤ 59... ≥ 100	3527	Men 44.8 (mean)	
• The MATISS Project[6]	< 70...≥ 90	2533	Men 40-69	9
	< 60...≥ 90			

1. Kannel W et al. Am Heart J 1985;109:876-85
2. Dyer A et al. Am J Epidemiology 1980;112:736-49
3. Gillum R et al. Am Heart J 1991;121:172-7
4. Wilhelmsen L et al. Eur Heart J 1986;7:279-88
5. Kristal-Boneh E et al. Eur Heart J 2000;21:116-24
6. Seccareccia F et al. Am J Pub Health 2001;91:1258-63

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Study	ACM	CVM	NCVM	Controlled co-variables
Framingham	-	S	-	
Chicago Gas	S (u) S (m)	S (u) NS (m), but SCD was S	S (u) S (m)	Age, BP, Chol, Smoking, Weight
Chicago Elect	S (u) NS (m)	S (u) NS (m)	NS (u) NS (m)	As above
Chicago Heart	S (u) NS (m)	NS (u) NS (m)	S (u) S (m)	As above
NHANES	S in whites and blacks	S in whites NS in blacks (underpowered)	S (white and black males)	Age, BP, Chol, Smoking, DM, BMI, alcohol
CORDIS	S	S	NS (cancer)	Age, Smoking, Chol, BMI, Physical activity, education, Plt, HB, WCC, Total Protein
MATISS	S	S	S	Age, BP, Chol, Smoking, BMI, Arm circumference, FEV1, DM

U = univariate, m = multivariate

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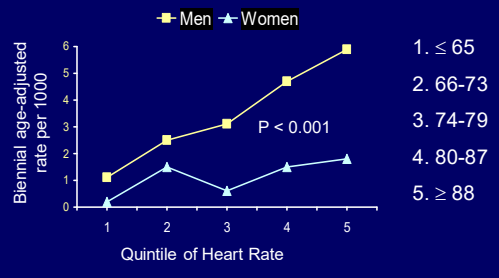
Sudden Death by Heart Rate on ECG

Framingham Study



Kannel et al. Am Heart J 1985;109:876-85

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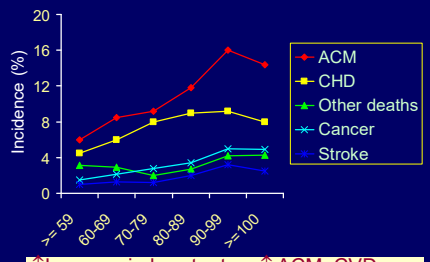
Heart Rate as Risk Factor in the General Population



↑Increase in heart rate = ↑ ACM, CVD
Independent of gender, ethnic background

Wilhelmsen L et al EHJ 1986;7: 279-88

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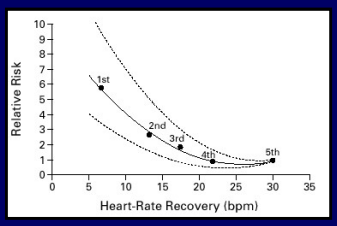
Heart Rate Recovery Immediately After Exercise As A Predictor of Mortality



- 2428 adults
- Age = 57± 12 years
- Men = 63%
- FU 6 years
- Symptom limited ETT
- Abnormal recovery of heart rate was defined as a reduction of 12 beats/minute or less at 1 minute post exercise.

CR Cole et al. N Engl J Med 1999;341:1351-7

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Heart Rate in Hypertensive Patients

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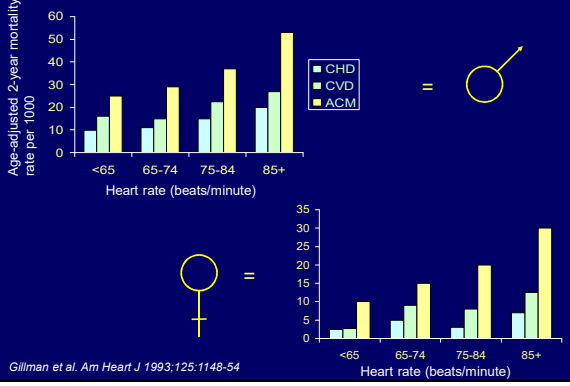
Heart Rate on mortality among persons with Hypertension: The Framingham Study



Gillman et al. Am Heart J 1993;125:1148-54

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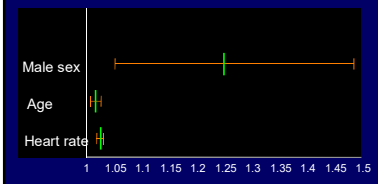
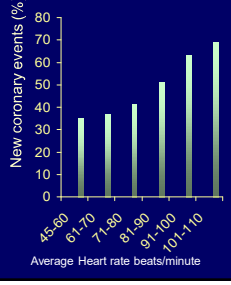
Heart Rate as A Prognostic Factor in The Elderly

- 1311 patients with heart disease and sinus rhythm
- average heart rate on 24-hour Holter
- mean age 81 years
- 48-months follow-up



Prognostic variables for new coronary events using multiple logistic regression analysis.



Aronow et al. Am J Cardiol 1996;78:1175-6

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Ischaemic Heart Disease

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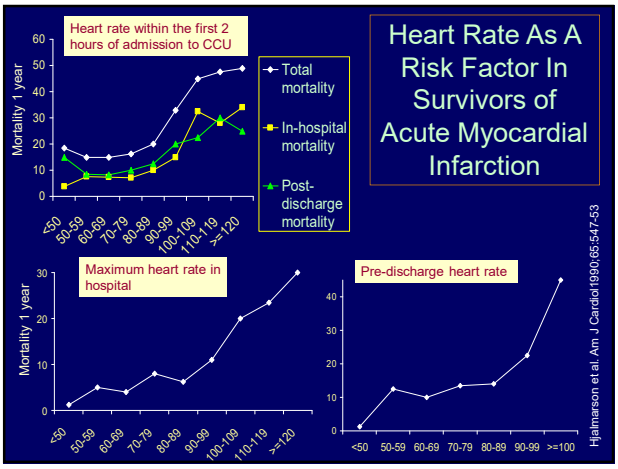
Heart Rate As A Risk Factor In Survivors of Acute Myocardial Infarction



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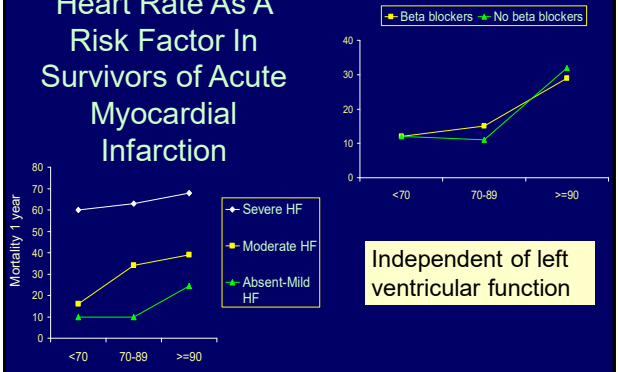
Heart Rate As A Risk Factor In Survivors of Acute Myocardial Infarction



Independent of left ventricular function

Hjalmarson et al. Am J Cardiol1990;65:547-53

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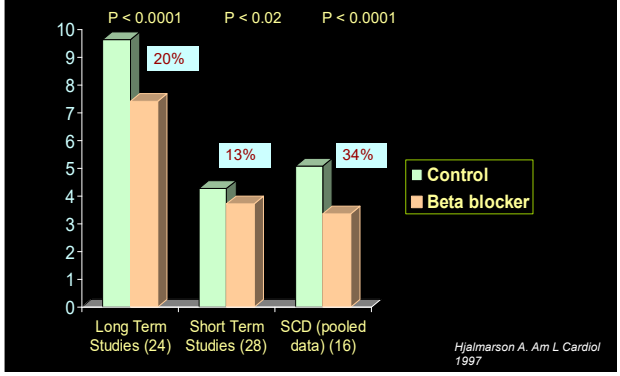
Beta Blockers Post MI



Hjalmarson A. Am L Cardiol 1997

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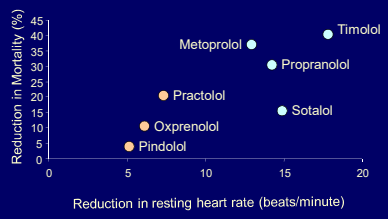
Beta Blockers Post MI

ISA versus Non ISA Beta Blockers



Kjekshus et al. Am J Cardiol 1990;65:547-53

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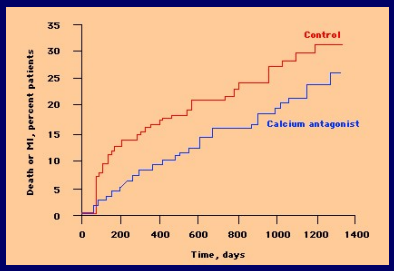
Calcium Antagonist Post MI Post MI



Long-term effects of diltiazem and verapamil on mortality and cardiac events in non-Q-wave acute myocardial infarction without pulmonary congestion; MDPIT and DAVIT II.

Gibson et al. Am J Cardiol 2000 Aug 1;86(3):275-9

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Heart Failure

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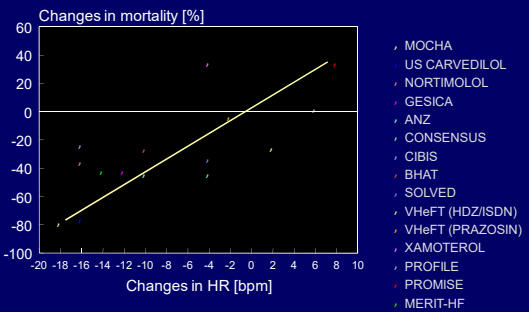
Heart Rate and Mortality in CHF



- MOCHA
- US CARVEDILOL
- NORTIMOLOL
- GESICA
- ANZ
- CONSENSUS
- CIBIS
- BHAT
- SOLVED
- VHeFT (HDZ/ISDN)
- VHeFT (PRAZOSIN)
- XAMOTEROL
- PROFILE
- PROMISE
- MERIT-HF

Kjekshus et al. Euro Heart J 1999;Suppliment H: H64:69

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Beta Blockers, Heart Failure and Arrhythmias

Study	Drug	Sample size (Follow up)	End point	Sudden cardiac death
Parker et al *NEJM 1996*	Carvedilol vs placebo	1094 (6-12 months)	↓ in all cause mortality 3.2%,vs 7.8%, p<0.001	55% reduction 3.8% vs 1.7%
CIBIS 2 *Lancet 1999*	Bisoprolol vs placebo	2647 (1.3 years)	↓ in all cause mortality 11.8% vs 17.3%, p<0.0001	42% reduction 3.6% vs 6.3%, p<0.0011
MERIT *AHA i998*	Metoprolol vs placebo	3991	↓ in all cause mortality, 7.2% vs 11.0%, p<0.0001	41% reduction 4% vs 6.6% p =0.0002

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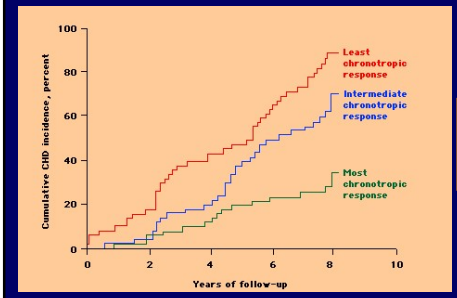
Chronotropic Incompetence, CHD and All Cause mortality



Framingham Heart Study

1575 males

Lauer MS, et al. Circulation 1996;93:1520-6

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Cancer

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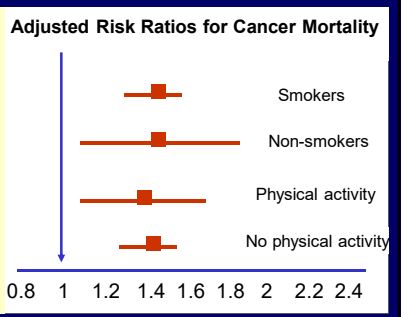
Heart Rate as a Risk Factor for Cancer

- 125,513 men
- Age 20-95 years
- Heart rate: < 60, 60-80, >80 beats/minute
- Adjusted for smoking,, exercise.



Thomas F et al. J Clin Epidemiol 2001;54:735-740

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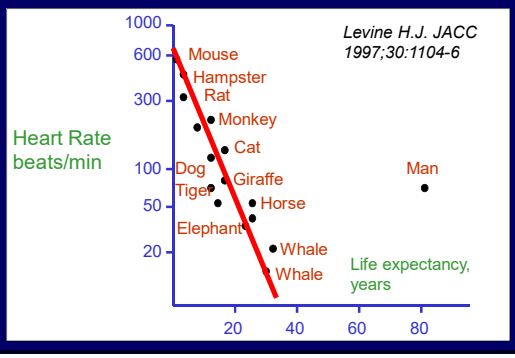
Relation between Rest Heart Rate and Life Expectancy in Mammals.



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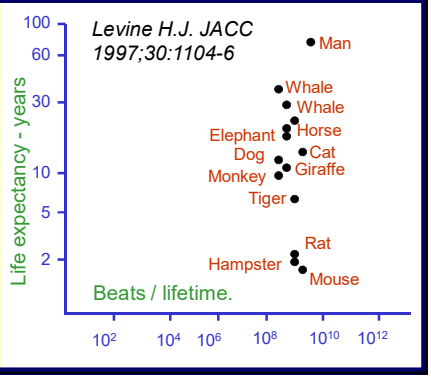
Relation between Life Expectancy and Total Heart Beats/Lifetime

"This indicates that life span is predetermined by basic energetics of living cells and that heart rate is a main determinant of life expectancy"



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How does heart rate affect cardiovascular mortality?

1. Decrease in myocardial oxygen demand.
   - Heart rate, myocardial contractility, end-systolic wall stress
2. Increase diastolic coronary blood flow time
3. Reduction in infarct size
4. Increase in ventricular fibrillation threshold
5. Antiatherogenic effect
   - Observational animal studies
6. Poor health and/or physical fitness
7. Autonomic nervous system abnormalities

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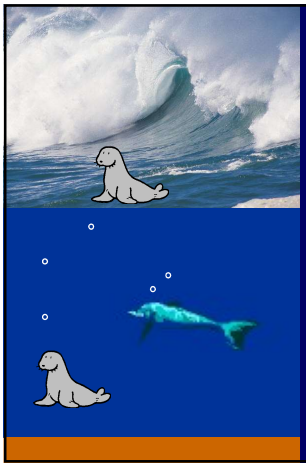

Importance of physiological heart rate reduction.

Heart rate on surface = 90-100 beats/minute

Heart rate when submerged = 6-10 beats/minute.

↓

Significant reduction in myocardial oxygen demand. Allowing submersion for 15-60 minutes.

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↓

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